Forest Health Technology
ENTERPRISE TEAM UPDATE

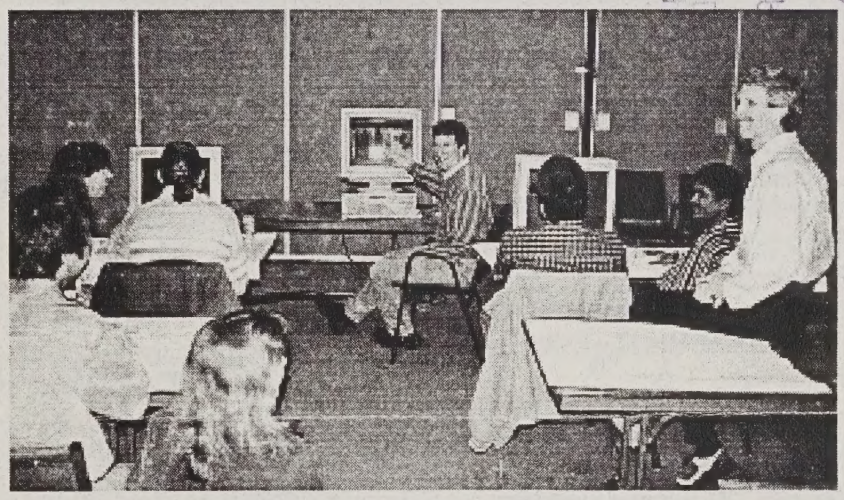
USDA FOREST SERVICE, STATE AND PRIVATE FORESTRY, FOREST HEALTH PROTECTION, FOREST HEALTH TECHNOLOGY ENTERPRISE TEAM

SPRING 1999

Cooperation produces short course at national tribal timber symposium

The Enterprise Team, the Central Oregon Insect and Disease Service Center, the Forest Management Service Center (FMSC) and the Bureau of Indian Affairs (BIA) partnered to develop and present a one-day short course on Forest Vegetation Simulator (FVS) at the twenty-third Annual National Indian Timber Symposium held at Kah-neeta Resort and Conference Center, Warm Springs, Oregon.

FVS is a growth and yield model used to project the effects of various management activities within forest stands over time. It is supported by FMSC and available as an analytical tool to natural resource managers throughout the United States and Canada. The Enterprise Team supports the development and maintenance of forest insect and disease models as extensions to FVS.



USDA FOREST SERVICE, ENTERPRISE TEAM

Enterprise Team's Matt Oberle (then with Autometric Service Company) demonstrates a feature of one of the Forest Vegetation Simulator insect and disease models.

Since wood fiber, recreational, and other social amenities produced by forests are significant contributors to many tribal economies and cultures, interest in new and useful science and forest management tools is high. Sharing knowledge

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Inside . . .

Field staffs review landscape-based bark beetle model

Representatives from Regional Forest Health Protection units and Forest Service Research and Development met in March 1999 to address the status of the Westwide Pine Beetle Model (WWPB), the meaning of preliminary results, and future direction for the project.

The complex and ambitious task of creating a WWPB Model began as a Special Technology Development Project in 1992. The Enterprise Team took on the job of evaluating, testing, and improving the software created through that project. The WWPB model is designed for use with the Forest Vegetation Simulator (FVS), the Forest Service's primary stand growth model. A multi-stand, landscape impact model of the effects of pine bark

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and skills among Tribal Council, BIA, and Forest Service can help tribes maintain both healthy forests and a healthy Tribal economy.

Workshop attendees participated in hands-on demonstrations of how FVS, together with the Insect and Disease Models, can be important decision support tools at a number of levels of forest planning, including environmental assessments, late successional reserve analyses, watershed analyses, and forest plans. The training session took potential users through a series of increasingly complex exercises demonstrating features of FVS, the Insect and Disease Models, and Suppose, a graphical user interface for FVS. Primary resource emphasis ranged from timber production to the protection and development of wildlife habitat.

Helen Maffei (Acting Enterprise Team Technology Transfer Program Manager and Pathologist Central Oregon Service Center); Judy Adams of the Enterprise Team; Matt Oberle, contractor with Autometric Service Company, who recently joined FMSC as a federal employee; and Don Vandendriesche of FMSC designed the Warm Springs short course. John Arena and Mark Brown of the BIA, who were in charge of local arrangements, said reactions to the training were very positive and that FVS/Suppose would be helpful in tribal forest planning. A direct impact of the Warm Springs Training will be the development of baseline trends for the current western spruce budworm outbreak on the Yakima Indian Reservation using the western spruce budworm model. The effects of mistletoe will also be incorporated into the forest planning for several other reservations.

The short course can be brought to your area as a two-day session with several options available. We can provide local staff with the materials and exercises to put on the short course themselves, or we can work with the local staff to prepare and present the session. The Fremont National Forest and Deschutes National Forest have already requested sessions. For more information contact Helen Maffei (541-383-5591 or hmaffei/r6pnw,deschutes) or Judy Adams (970-498-1727 or jadams/wo,ftcol).

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ENTERPRISE TEAM UPDATE

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beetles on western pine forests, the WWPB model simulates impacts of mountain pine beetle, western pine beetle, and *Ips* species on lodgepole and ponderosa pine.

Staffs discussed strengths and weaknesses of the WWPB and decided that the Enterprise Team should pursue integrating WWPB with FVS and with Suppose, a graphical user interface.

The Team will then work with the Regions to further test and evaluate WWPB, which considers beetle dynamics on the landscape or watershed level (typically 5,000 to 50,000 acres), based on large-scale beetle activities and forest conditions for groups of stands. The attempt to model these activities on a larger scale is a departure from other FVS insect and disease extensions, which model interactions at the stand level (typically 5 to 100 acres).

Enhancements to WWPB are making the model more user-friendly. The model creates outputs that display data in ARC GIS systems to enable stand-by-stand visualization of results.

The Enterprise Team worked with the Gunnison Service Center of the Rocky Mountain Region to demonstrate the use of the model on the Piney project on the White River National Forest. Enterprise Team Program Manager, Dr. Eric L. Smith, presented preliminary simulation results using project data. Further development will incorporate feedback from meeting participants, and improvements will allow more realistic representation of actual landscapes.

The consensus at the March meeting was that WWPB could be useful

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in analyzing alternative scenarios of the interaction of beetle activity, forest conditions, and management options. The model's structure also lends itself to future use for other bark beetles (e.g., Douglas-fir bark beetles), as it allows consideration of factors such as weather along with hosts and pests, and because it looks at the landscape level.

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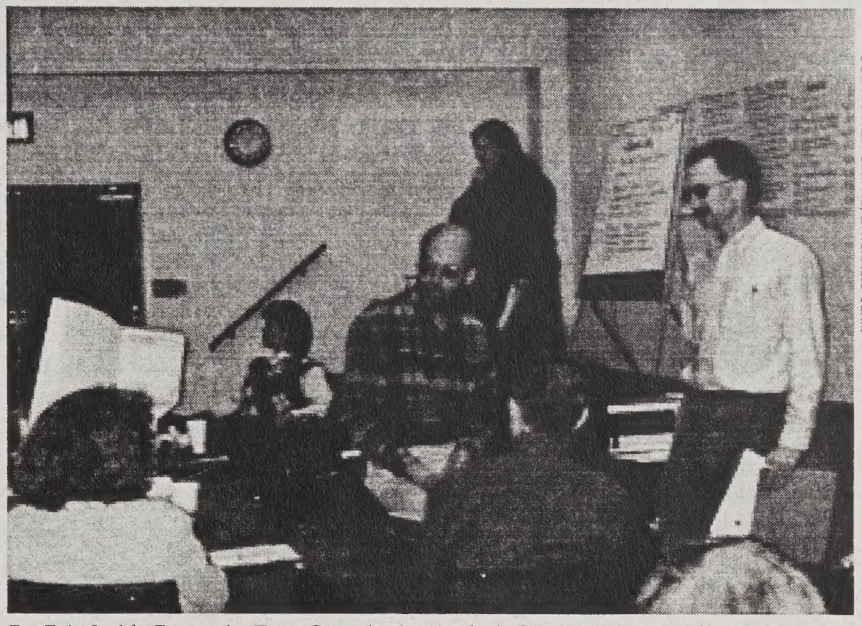

USDA Forest Service, Enterprise Team

Dr. Eric Smith, Enterprise Team Quantitative Analysis Program Manager, discusses Westwide Pine Beetle Model functions with Regional representatives. Andy Mason , Enterprise Team-FC Director, listens, right.

Aerial spray model adds GIS

Since the 1970s the USDA Forest Service has worked to increase the accuracy and safety of pesticide application through the development, evaluation, and validation of computer models for simulating pesticide application. Because problems of access and size of spray blocks make ground application impractical in many Forest Service application scenarios, these efforts have largely focused on aerial spraying. The information pesticide application models yield is typically in mass/area over some specified area. The Forest Service Cramer-Barry-Grim (FSCBG) model yields mass (or droplets) /area across an idealized spray block. The model output is effectively spatial information; however, currently model users need to make the leap to overlay this information onto an actual map base.

Over the last three years, work has been ongoing to integrate pesticide spray modeling into a Geographic Information System (GIS). Developers of FSCBG are collaborating with the developers of GypsES, (Gypsy Moth Expert System, a software decision support system used to support gypsy moth suppression and eradication projects) from the Southern Region and the Northeastern Area to integrate FSCBG into a system with GIS capabilities.

The GypsES model offers the ideal home for the spray models, as it is a GIS-based pest management tool. Developed originally to aid in the management of gypsy moth outbreaks in the eastern U.S., it is now used as a generic pest management platform.

Originally, integration of FSCBG into GypsES allowed users to overlay the plume, that is, the spacial representation of the pesticide spray deposition predicted by the FSCBG model, onto an actual spray block as a map layer in GypsES' GIS. This integration has evolved. Currently the model user can combine the near-field portion of the FSCBG model with actual flightlines downloaded directly from an in-cockpit Digital Geographic Positioning System (DGPS) guidance system to yield a map overlay of the spray deposition.

All of the USDA Forest Service spray modeling tools should be available at one web site sometime in the year 2000. In the meantime, contact Dan Twardus of Northeast Area Forest Health Protection (dtwardus/na,mo or dtwardus/na_mo@fs.fed.us) or Harold Thistle (hthistle/na,mo or hthistle/na_mo@fs.fed.us) for more information.

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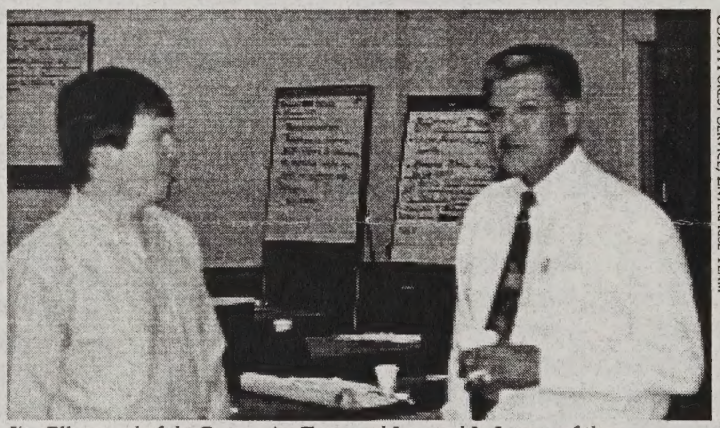
FHP Directors continue support for aerial imagery program

Forest Health Protection Directors agreed to continue FHP remote sensing aerial photography programs at their current levels and to seek funding for replacement of a camera in the Southern Region and recruitment of two trainee photographers at their April 1999 meeting. A Forest Service team evaluated alternatives to Forest Health Protection's current methods of acquiring aerial imagery (sketch-mapping excluded).

The evaluation team included representatives from the Enterprise Team's Remote Sensing services Team, the Remote Sensing Application Center (RSAC) and Forest Health Protection staff from the Southern Region, Northeastern Area, the Southwestern Region, the Pacific Northwest Region, and Alaska. The team, meeting in Fort Collins, Colorado, early in February 1999, identified current capabilities for aerial image acquisition and technology development related to aerial imagery at the Enterprise Team, RSAC, and the regions. Capabilities reviewed included aircraft, remote sensing equipment, and staffing.

Although several FHP units have aerial imagery acquisition capabilities, levels of capability vary. The team recognized a general need to better coordinate the resources among the various units to ensure that smaller, remote FHP units receive needed services.

Several aircraft are available to the program; however, most of these are not available during the field season. Only two are dedicated to FHP remote sensing. The team identified the general need to work with Aviation to ensure appropriate costs are being charged. Although in-service projects presently cover costs of operation, replacement of depreciated equipment and training of personnel are not factored into project costs. Continuing the current program without plans to maintain and replace equipment and train personnel would eventually result in loss of equipment, expertise, external partnerships, and ability to meet stakeholders' needs. The evaluation panel concluded that such program deterioration would also have negative impacts on assessment and suppression activities, as well as the rapid-response capability demanded in emergency scenarios such as the recent blowdown on the Routt National Forest and hurricanes in the Southern Region.



USDA Forest Service, Enterprise Team

Jim Ellenwood of the Enterprise Team and Leonard L. Lucero of the Southwestern Region during a break in the FHP Directors meeting.

The team made recommendations regarding FHP's regional and national needs for aerial imagery and identified and evaluated alternative ways to address these needs. The review committee considered four alternatives: *status quo*, contracting all aerial image acquisition, contracting aircraft and pilot only, and maintaining the existing programs at their current levels and capabilities. Evaluation criteria for these alternatives were direct cost, staffing, timeliness of response, knowledge and skill base, and quality assessment and control. The preferred alternative, maintaining existing programs at current levels and capabilities, would maintain quick response for partners and stakeholders while keeping the skill base for these programs within the Forest Service. This alternative recognizes the need to replace aging equipment either through excess property or purchase. Also recognized are the need to provide trainee positions to acquire skills that would be lost due to retirement in the near future.

FHP Directors adopted the committee's recommendation, citing the program's usefulness.

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PTIPS moves to Enterprise Team

Forest Health Protection Directors transferred administration of FHP's Pest Trend Impact Plot System (PTIPS) to the Enterprise Team at its April, 1999 meeting. The program has been administered by Arizona Zone Leader Borys Tkacz. Begun as a Special Technology Development project (STDP), PTIPS has been supported and funded with STDP funds for the past nine years. The project established forest plots throughout the West, together with a database of information about the impacts of forest insects and pathogens. The plot system was originally designed and will continue to be used for the validation and calibration of insect and disease models. The Enterprise Team and one of its predecessors, the Methods Application Group, contributed to the development of the database management system, which was recently incorporated into FSVEG, the Forest Service's new database system for field-sampled vegetation.

USDA Forest Service, Enterprise Team

Borys Tkacz, center, with Jerry Boughton (Alaska Region), at left, and Richard Teck (Forest Management Service Center), right, at Forest Health Protection Directors meeting.

The most recent review of PTIPS conducted by the STDP Steering Committee concluded that the project's original objectives are still valid and that PTIPS has made considerable progress toward meeting them, especially in the establishment and measurement of plots. The system's design is set up on different measurement schedules, some annual, some longer term, depending on the appropriate time line for the pests being measured. Analysis for model validation and calibration will take more time, as some plots are just now entering the appropriate status for validation and calibration.

The project provides useful information for resource management in the West. The STDP Steering Committee recommended continuing PTIPS and moving administration of the project to Enterprise Team-Fort Collins. The committee also recommended that the program be expanded to include the East and the South, that it be designated a national program, and that alternative funding sources be sought. The project now uses a substantial portion of annual funding for STDP, which limits the support available for other valuable technical development projects.

FHP Directors accepted these recommendations and determined first, that the program be housed at the Enterprise Team-Fort Collins site, and second, that the program be expanded to include the Northeastern Area and the Southern Region, depending on approval of a PTIPS implementation plan and availability of funds. PTIPS will be continued and additional STDP funding will be sought to restore that program to the 1999 level.

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Maffei energizes Team communications

Helen Maffei, acting Technology Transfer Program Manager in April, is producing a promotional "successes" brochure on STDP. This project, along with helping to conduct a training short course for the Intertribal Timber Conference and shepherding Enterprise Team projects like the *Update* through the production process, were the focus of her detail at Enterprise Team-Fort Collins in April 1999. Helen's regular assignment is with the Insect and Disease Service Center, Pacific Northwest Region, in Bend, Oregon. Her dynamo personality and working style energized the Enterprise Team during her stay with us and continues to do so back at her Region 6 post.

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Study's focus: future of microbial insecticides for control of gypsy moth

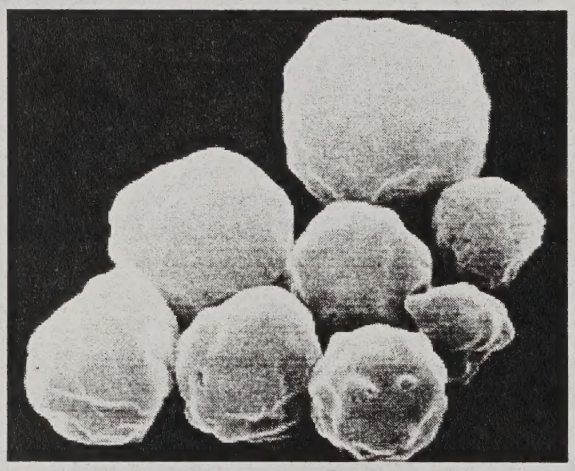
An Enterprise Team-Morgantown microbial insecticide program focuses on two goals: to develop and improve the efficacy of microbial insecticides used to control forest defoliators and to collect information about the effects of these microbial insecticides on nontarget organisms. A nucleopolyhedrosis virus (NPV) and a bacterium are currently used to control gypsy moth, *Lymantria dispar* (L), in North America.

Nucleopolyhedrosis Virus

NPVs are unrelated to viruses that cause disease in humans and other mammals. Natural components of their host's habitats, they can reach epizootic (epidemic) proportions even without artificial application. Typically, each affects a narrow range of species. These characteristics make NPVs excellent candidates for use as insecticides; two such insecticides are Gypchek and Disparvirus. Scientists isolated a strain of the gypsy moth NPV from a Connecticut population of NPV-killed gypsy moth larvae. This "Hamden" strain is the active ingredient in the product Gypchek, registered by the U.S. EPA in 1978. The same active ingredient is in the product Disparvirus, registered in Canada but not currently in production.

The USDA Animal and Plant Health Inspection Service and the USDA Forest Service collaborate to produce approximately 5,000 acre equivalents (sufficient quantity to treat 5,000 acres) of Gypchek per year. Maintaining this level of production costs about $300,000 per year.

The active ingredient (the virus) is produced using a laboratory colony of gypsy moth. Processed powder is tank mixed either with a commercially produced carrier (Carrier 038, Abbott Laboratories) or with a lignosulfonate-molasses formulation—less costly but more difficult to mix and apply. The tank mix is sprayed on foliage in the crowns of trees, where small gypsy moth larvae eat the contaminated foliage and die. Larval cadavers then disintegrate and serve as inoculum for healthy feeding larvae.



USDA Forest Service

Occlusion bodies of the gypsy moth nucleopolyhedrosis virus under magnification.

Transmission of gypsy moth NPV occurs both within and between generations of the insect. Gypsy moth NPV appears to have minimal indirect effects on a few gypsy moth parasites, but scientists have not documented effects on other nontarget organisms.

Bacteria

The *Bacillus thuringiensis* Berliner group of bacteria (commonly referred to as *Bt*) is used extensively to control agricultural and forest insect defoliators as well as insect vectors of human and other mammalian transmissible disease. *B. thuringiensis* occurs naturally in many species of agricultural and forest insects and is a component of soil microbiota worldwide. Most strains used in commercial production of microbial insecticides were isolated from diseased insects. *Bt* does not cause epizootics without artificial application.

Most formulations of *Bt* used to control defoliating Lepidoptera (butterflies and moths) in North American forests today are *Bacillus thuringiensis* variety *kurstaki* (HD-1 strain) (*Btk*). Private industry producers, Abbott Laboratories and Thermo Trilogy, produce large quantities of several formulations of the HD-1 strain of *Btk* for use against gypsy moth. Like Gypchek, *Btk* is a stomach poison (insect larvae eat the bacteria, get sick, and die; mere contact with the bacteria does not kill larvae).

Btk action is complex, and scientists are not sure exactly how it works. Larval death is associated with both bacterial spores and crystals. In most lepidopteran pests, the cause of death is smaller proteins released in the insect's gut by the bacteria's crystal component; the spore's effect is minimal. Scientists have documented direct and indirect impacts of *Btk* on various nontarget Lepidoptera.

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Btk-treated acres make up more than 99 percent of the acres treated aerially with microbial insecticides as part of the Federal and State Cooperative Suppression, Eradication, and Slow-the Spread Programs. *Btk*'s large share of the total program is dictated by its commercial availability in large quantities, in various formulations, and at relatively low cost.

USDA Forest Service

Bacillus thuringiensis deposit and killed gypsy moth larvae on foliage.

In contrast, only one commercially available tank mix of Gypchek is available. Gypchek quantity is limited and its production cost relatively high. A fairly large dose is needed to provide consistent insect mortality. In general, Gypchek takes longer than *Btk* to cause gypsy moth larvae to stop feeding or die. The product's effectiveness at low host densities is not well documented.

Aerial Application and Non-target Concerns

During the past five years, concern with real and perceived impacts of aerially applied microbial insecticides on non-target Lepidoptera has increased. Previous field studies implicated *Btk* as the cause of within-season depressions of selected non-target lepidopteran larvae, although in most cases the affected species recovered by the end of the following year. Results of laboratory bioassay studies on a limited number of native Lepidoptera show that most of the small instar larvae were susceptible to *Btk*; susceptibility of mid- or late instars is less clear. Gypchek has not been implicated as impacting non-target Lepidoptera in either laboratory or field studies.

Since *Btk* has been implicated as affecting lepidopteran larvae other than the target species, what can be done to maintain its level of use and lessen its impact on nontarget species? One possible solution is to develop target-specific strains of *Btk*. Worldwide, more than 15 manufacturers of biopesticides are developing natural strains of *Bt*; developing genetically manipulated strains of *Bt*; and transferring toxin-coding genes into other bacteria (by cloning) or into selected plant species, creating transgenic plants. These approaches offer promise, but unfortunately the outlook for more species-specific *Btk* strains for use in forestry is not good, at least for the next 5 years, because the market for *Btk* in forestry is so limited.

Another possible solution is to conduct laboratory bioassays of *Btk* effects on a wide range of non-target lepidopteran species, especially on threatened or endangered species of Lepidoptera (as well as other species of special concern). This approach would be very expensive, because of the large number of species. Additional limitations apply to bioassays of *Btk* effects on species of specific concern because of their limited numbers and because of restrictions on collecting these species. Finally, even if sufficient numbers were available, the results of laboratory bioassays may not accurately represent results in the field.

Still another possible solution is to decrease the use of *Btk* and increase the use of Gypchek. But the future for commercial production of Gypchek is not promising because of the high costs of in vivo production and the limited market in forestry. Nor has the effort to improve the efficacy of Gypchek by developing more virulent natural and genetically engineered strains of gypsy moth NPV proven to be a viable option.

Ongoing long-term study

An ongoing, long-term study initiated by the National Center of Forest Health Management (now Enterprise Team-Morgantown) in 1994 aims to determine the impacts of sequential treatments of *Btk* and Gypchek on selected groups of non-targets located on a series of 500-acre plots on the George Washington National Forest in Virginia and the Monongahela National Forest in West Virginia. The study monitored the replicated plots in 1995 and 1996, before treatment. The plots were treated in 1997 and 1998. After-treatment monitoring followed in 1998 and is scheduled for 1999 and 2000. This study should help to supply some of the informa-

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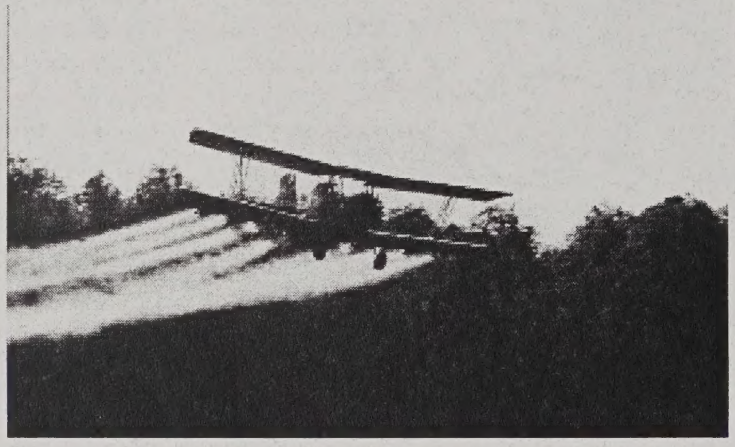
tion necessary to better our understanding of the effects of *Btk* and Gypchek on non-targets.

What next?

While the currently registered *Btk* products will continue to be used to control gypsy moth, they must be aerially-applied only after conducting site-specific biological evaluations of associated non-target Lepidoptera and gypsy moth population characteristics. Once non-target species are identified, thought should be given to mitigating potential impacts of *Btk* on them.



USDA Forest Service

Aerial application of Bacillus thuringiensis *to control gypsy moth.*

We can estimate potential risk based on length of lethal activity of *Btk*, laboratory bioassay data, and the particular life stage of the non-target species present during aerial applications of *Btk*. Unfortunately, much information is needed about geographical range, larval host plants, and habitat associations of nontarget species. Meanwhile, program personnel might consider using a *Btk* formulation that is more specific to gypsy moth (e.g., Foray 48F) rather than formulations that impact a broader range of lepidopteran species.

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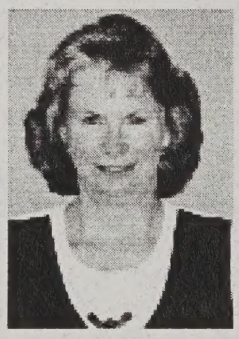
Haynes, Scrivner honored



Georgia Haynes, Enterprise Team-FC

Georgia Haynes of Enterprise Team-Fort Collins was recognized in March with an "On-the-Spot" award for support services to the Forest Management Service Center (FMSC) and the Enterprise Team during 1998-1999. Georgia helped FMSC with travel matters and with conversion from the DG system to the IBM corporate system. She handles a wide spectrum of support duties for the Enterprise Team with skill and aplomb.

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Sally Scrivner, Enterprise Team-FC

Sally Scrivner of Enterprise Team-Fort Collins earned an award for outstanding support services for the Forest Health Protection Directors Meeting held at the Enterprise Team-Fort Collins site in April 1999. Sally also does yeoman service preparing presentations and graphics for the *Update* and other Enterprise Team documents, poster displays, and presentations.

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Editor departs

At the end of May, Shirley Wilsey (with Autometric Service Company), writer and editor-extraordinaire for the Enterprise Team *Update*, will be moving to a new contract position with the Natural Resources Conservation Service. Shirley has provided the Enterprise Team with years of perspicacity, perception, creativity, and attention to detail in reports, plans, papers, and poster sessions—not to mention what she has done for our vocabularies! We will miss her patience. We will miss her humor. We will miss her hats.

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Reader's comment form

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Events of Interest

June 30-July 1, 1999. Washington, D.C. Forest Health Technology Enterprise Team Steering Committee Meeting.
Contact: Andy Mason, USDA Forest Service, Forest Health Technology Enterprise Team, 3825 E. Mulberry St., Fort Collins, CO 80524; 970-498-1784; fax: 970-498-1660. amason/wo,ftcol; amason/wo_ftcol@fs.fed.us

July 4-9, 1999. Bozeman, MT.
X International Symposium on Biological Control of Weeds.
Contact: Allan T. Bullard, Forest Health Technology Enterprise Team, 180 Canfield St., Morgantown, WV 26505; 304-285-1563; fax: 304=285-1564; abullard/na,mo; abullard/na_mo@fs.fed.us

August 2-5, 1999. Pensacola, FL.
1999 Southern Forest Insect Work Conference.
Contact: Kier D. Klepzig, USDA Forest Service, 2500 Shreveport Hwy., Pineville, LA 7136. 318-473-7238. kklepzig/srs_pineville@fs.fed.us

September 13-17, 1999. Breckenridge, CO.
1999 Joint Meeting of the Western International Forest Disease Work Conference and the Western Forest Insect Work Conference
Contact: Jane Taylor (WIFDWC) 406-329-3463 or Terry Rogers (WFIWC) 505-842-3287. http://fsweb.ftcol.fs.fed.us/wo-fc/fhtet/combine1999